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Land Utilization and Reclamation in the Mining Industry, 1930-80

By Wilton Johnson and James Paone



UNITED STATES DEPARTMENT OF THE INTERIOR

(United States Bureau of Mines)

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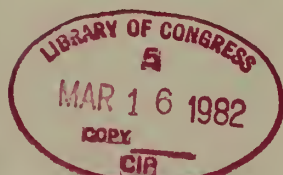
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BUREAU OF MINES

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As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.

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LAND UTILIZATION AND RECLAMATION IN THE MINING INDUSTRY, 1930-80

by

Wilton Johnson¹ and James Paone²

ABSTRACT

The Bureau of Mines study indicates that land utilized by the mining industry for mineral extraction and processing from 1930 through 1980 amounted to 5.7 million acres, or 0.25 percent of the land mass in the United States. Land reclaimed by the industry during the same period was 2.7 million acres, or 47 percent of the land utilized. Land use by the mining industry includes surface land used for excavation or mining, for waste from underground mining, and for wastes from milling or processing operations. Data on land use for disposal of overburden waste from surface coal mines and on areas affected by subsidence associated with underground mining are included for the period 1930-71 only.

The 10 leading States in total land used for mining over the 51-year period were, in decreasing order, Pennsylvania, Kentucky, Ohio, Illinois, West Virginia, Florida, Indiana, California, Alabama, and Missouri. Seven mineral commodities accounting for 92 percent of land use are, in decreasing order, bituminous coal, sand and gravel, stone, phosphate rock, clay, copper, and iron ore, all predominately surface mined. Bituminous coal production was responsible for nearly half of the total area utilized.

Reclamation of mined lands and waste disposal sites over the reporting period was largely on lands utilized in mining bituminous coal; 75 percent of the land used for bituminous coal production was reclaimed.

INTRODUCTION

This study was conducted by the Bureau of Mines to determine the amount of land used by the mining industry to produce coal and nonfuel minerals needed to maintain the Nation's security and economic well-being. Mining, of necessity, except ocean mining, requires the use of land to support mineral extraction and processing activities. Unless properly reclaimed, mined land

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is sometimes permanently removed from other productive uses and adversely impacts environmental, aesthetic, and other values of the mining site and surrounding areas.

Public concern for protection of these values often triggers various kinds of responses, often in the form of Federal, State, and local laws or other regulatory controls. Developing such controls or formulating land use decisions without adequate data can affect mineral exploration and development activities and ultimately the availability of minerals to meet our domestic needs. Detailed information on mine land use is therefore crucial to the decision making process. This report represents a continuing Bureau effort to facilitate that process by assessing the nature and extent of land used for mining and mineral processing activities and the degree to which these lands are reclaimed for other productive uses.

Background

The Bureau of Mines has a long history of interest in mine land use and reclamation. For example, in 1939 the Bureau published Report of Investigations 3440, "Reclamation of Stripped Coal Land," to acquaint mine operators and others with work that had been done in certain States to reclaim land that had been strip-mined for coal.

The Bureau's interest in mine land use was broadened considerably with passage of the Appalachian Regional Development Act in 1965. The Act directed the Secretary of the Interior to survey strip and surface mining operations in the United States. The Secretary was also directed to make recommendations for a comprehensive program for reclamation and rehabilitation of strip-and surface-mined areas. The Bureau of Mines was ultimately instructed to assume leadership of a working level technical committee composed of various Federal agencies to study the nature and extent of surface mining operations and conditions resulting from them. The results of the study were published in a Department of the Interior Special Report to the Nation, "Surface Mining and Our Environment." The study identified 3.2 million acres of land affected by surface mining, 2 million acres of which were in need of varying degrees of treatment. The report also made specific recommendations, including establishment of Federal standards and requirements, for prevention of future damage and a program of Federal participation for repair of past damages.

Because of the potential for Federal intervention in mining and reclamation activities, a need emerged for reliable data to serve as a base for making viable mine land use decisions. To help fulfill that need, the Bureau continued its efforts to develop and maintain data on the extent of land use by the mining industry. In 1971, a second national survey was undertaken to identify the amount of land used and reclaimed by the mining industry during the 42-year period, 1930 through 1971. Unlike the first study, the survey was broadened to include surface areas affected by surface and underground mining, including mineral processing and waste disposal activities. The study identified 3.65 million acres of land used by the mining industry during that 42-year period. Of that amount, 1.46 million acres was reclaimed according to requirements of Federal, State, or local laws, or voluntarily when no such laws existed.

A subsequent Bureau report published in 1979, "Abandoned Coal-Mined Lands, Nature, Extent, and Cost of Reclamation," revealed that approximately 1 million acres of coal lands mined between 1930 and 1971 remained in an abandoned state. However, the report also noted that although an additional 400,000 acres was used for coal mining between 1972 and 1977, there was no significant increase in abandoned coal mined lands because of Federal and State laws requiring reclamation.

There was no comparable data for the amount of abandoned or unreclaimed land left by the metal and nonmetal mining industries. There are no Federal laws requiring reclamation of land mined for nonfuel minerals, and State laws governing reclamation of mineral mined lands are not as extensive as those governing coal mining. Other factors affecting abandoned mined lands are natural reclamation, voluntary reclamation performed by various industries, and reclamation by Federal, State, and local government agencies for such uses as farming, grazing, road construction, and residential and industrial complexes. For this reason, this report makes no assessment as to the amount of unreclaimed land that remains in an abandoned or derelict condition.

Purpose

The purpose of this report is to update data developed in previous Bureau studies and to assess land use trends in the mining industry. A knowledge of such trends is critical to development of land use policy decisions and aids in promoting a better understanding of mine land use in relation to other competing uses for land.

Scope and Methodology

This report identifies quantities of land used and reclaimed by the mining industry for different mining functions for the period 1930 through 1980. Included are data on areas affected by surface and underground mining and surface areas used for milling, processing, and related activities. Data for 1930-71 were obtained by soliciting information directly from individual mine and mill operations. For this report, a combination of industry and State surveys, production records, and Bureau of Mines estimates was used to determine the amount of land utilized from 1972 through 1980. As extraction of coal accounts for the major quantity of land used for mining, the Bureau, in 1976, conducted a special canvass of the coal mining industry to determine amounts of land used for various coal mining activities from 1972 through 1975, and amounts of land that had been reclaimed during that period. Approximately 6,000 questionnaires were mailed to coal mining companies that had operated at any time during the period January 1, 1972, to December 31, 1975. Response was voluntary, and cooperation was commendable. Responses accounted for 60 percent of the bituminous coal production for the 4-year period, providing an excellent sample and cross section of coal mining in each State and thereby providing a sound data base to estimate for nonrespondents.

Results were tabulated and statistically analyzed. Data not falling within prescribed bounds were screened, and illogical or erroneous information was discarded or corrected by telephone queries to reporting companies. Estimating formulas were devised for determining values for nonrespondents and for projecting acreage used and reclaimed through 1980. Formulas were based on acreage-production ratios of respondents and applied to operations of similar size and type conducted within the State or geographic region. Based on previous study experience, it was known that a high correlation exists between production and land use and that such factors as mining method and coal seam thickness could be used to make accurate estimates for nonrespondents or to validate response data.

Similarly, estimating procedures used to determine coal land utilization and reclamation were applied in projecting the amount of land used and reclaimed by the metal and nonmetal industries. Land use and reclamation data developed from the 1930-71 canvass of the minerals industry provided the data base for projecting land use and reclamation by the metal and nonmetal industries through 1980. Response to the 1930-71 survey represented 74 percent of minerals production in 1971, with metals accounting for 92 percent, and nonmetals for 66 percent. Like the special coal canvass, these responses provided an excellent sample of mining within each State. From these data, ratios were established relating the amount of land used to the amount of minerals produced on a commodity-by-commodity, State-by-State basis for each of the years 1972 through 1980. Ratios were refined to reflect changes in factors affecting mine land use trends since completion of the original 1930-71 survey.

Excluded from the estimates for 1972-80 are data on land used for disposal of overburden wastes from surface coal mining and surface areas subsided or disturbed as a result of underground workings. Data on acreage affected by disposal of overburden wastes from metal and nonmetal surface mining operations are included; however, the quantity of land used for overburden coal waste as a distinct category during the last 10 years is negligible because of State and Federal laws requiring reclamation concurrent with mining. Subsidence data were excluded because, lacking specific data from industry, such areas frequently cannot be determined accurately. However, areas affected by disposal of overburden coal wastes and by subsidence as reported by the minerals industry and State agencies represented approximately 9 percent and 4 percent respectively of total land use for 1930-71, and are included in total areas used and reclaimed from 1930 through 1980.

Areas occupied by mine plants are not included in this report because of the lack of reliable data. A canvass of the minerals industry reported acreage extremely larger than that normally occupied by mine plants. Detailed analysis of the data indicated that in some instances acreages reported included areas occupied by mill and processing wastes as well as mine plant facilities. Use of information reported in that category would have resulted in double-counting of acreages affected by mill and processing wastes.

Prospecting and exploration represent another form of land use by the mining industry. A study prepared for the Department of the Interior's Office of Minerals Policy and Research Analysis in 1979, titled "A Study of Issues in the Exploration and Development of Hard Rock Minerals," sought to determine the amount of land needed by hard rock mineral firms for site-specific exploration or physical exploration conducted on mineral land following the reconnaissance phase of exploration. Study results indicated that land needed for site-specific exploration varies widely among different operations and that the mine companies surveyed acquired from 600 to 10,000 acres or more before engaging in drilling, trenching, or the sinking of shallow shafts. Generally, additional lands were subsequently acquired. The study further showed that the amount of land actually needed for the mine itself can range from 5 percent or less of the total initially acquired, to nearly 100 percent in the case of some extensive, flat-lying bedded deposits that are mined by underground methods. Because of the uncertainties and variability of exploration data, such data were not included in this report.

Areas used for haulroads, fresh water reservoirs, railroads and public highways to edge of mining properties, and streams affected by acid drainage and sedimentation are excluded because of a lack of specific data from industry.

ACKNOWLEDGMENTS

The authors are indebted to individuals of many State agencies and to mineral producers for their voluntary contribution of land use and reclamation information. Thanks are also extended to the following Bureau of Mines personnel for their contribution and analysis of minerals production and land use data: Paul Marcus, physical scientist, Branch of Applied Technology and Demonstrations, Division of Mineral Environmental Technology; Leo Giorgetti, computer systems analyst, Branch of Data Management, Office of Mineral Information Systems; Barbara Gunn, statistical specialist, Branch of Domestic Data, Division of Production/Consumption Data Collection and Interpretation; and Patrick Ditty, physical scientist, Branch of Special Studies, Division of Mineral Land Assessment.

DEFINITIONS

Terms used in this report to describe the types of mining methods are those accepted by the mining industry in general. The term "surface mining" means mining in surface excavations and includes removing deposits or ore from open pits (quarries, opencuts), area stripping, contour stripping, auger mining, placer mining, dredging, and the removal of overburden to uncover the ore or deposit.

Open pit methods are employed in mining ore and deposits that lie near the surface. Overburden covering the mineral must be removed in advance of mining. Open pit mines range in size from simple, shallow excavations or borrow pits for recovering sand and gravel, and quarries producing limestone, sandstone, marble, and granite, to extensive and complex iron ore and copper open pits (fig. 1).



FIGURE 1. - Open pit copper mine.

"Strip mining" is the term commonly used in describing the surface mining method for coal. Two general types of strip mining for coal are contour stripping and area stripping. Contour stripping, common in the Appalachian region and some western coalfields, is a surface mining method of excavating for coal along the outcrop of the coalbed around the hillside. Area, or flatland, stripping is practiced in regions of rolling terrain with relatively flat upland surfaces such as those found in Illinois and western Kentucky. The open pit method is also used to mine coal with thick seam deposits such as those found in some Western States (fig. 2).

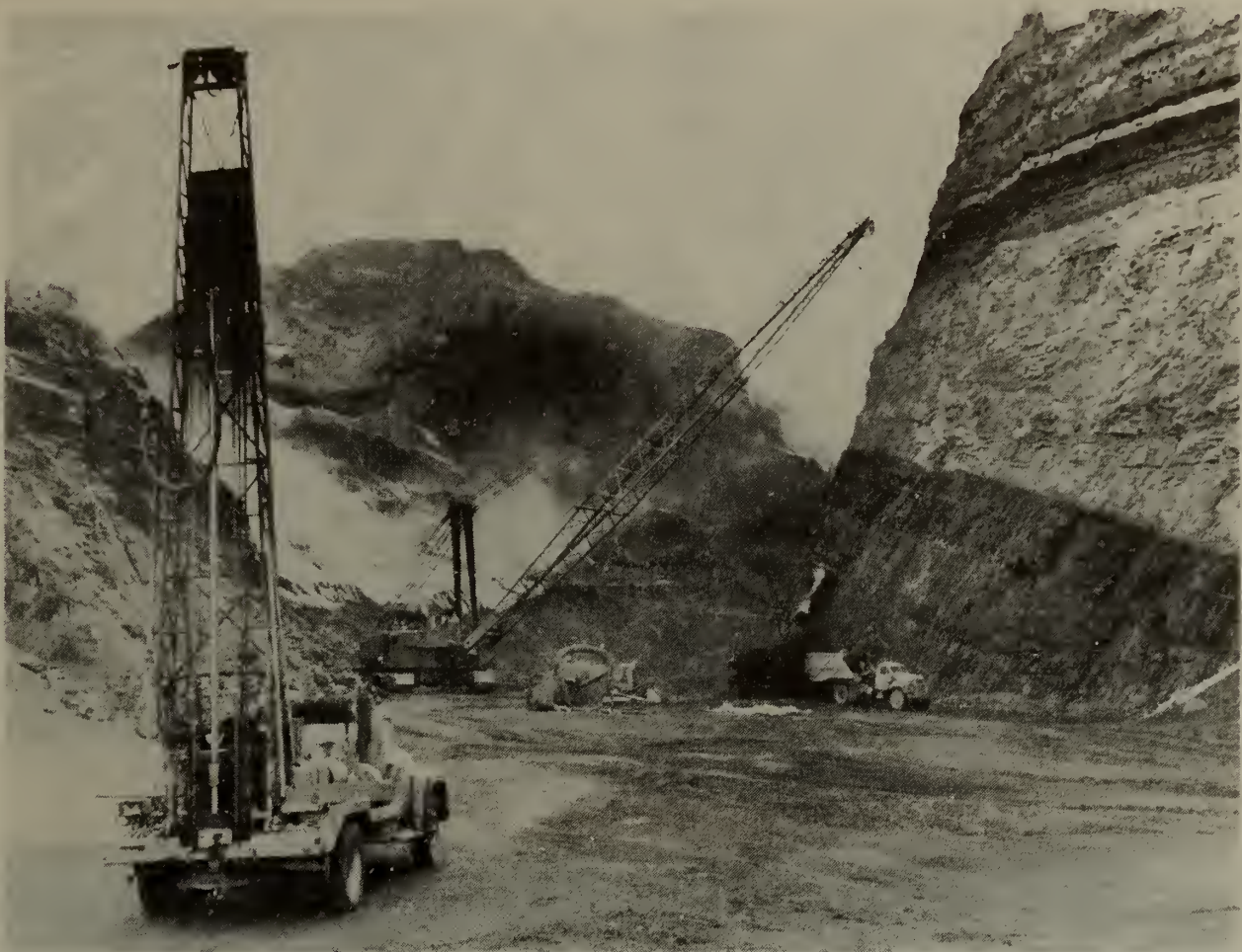


FIGURE 2. - Open pit coal mine.

Auger mining is a method often used by strip coal mine operators when the overburden is too thick to be removed economically. It involves large-diameter, spaced holes drilled up to 200 feet into the coal bed by auger (fig. 3).

Milling and processing involve dressing or beneficiation operations to remove unwanted waste (fig. 4) or impurities for the purpose of preparing coal and nonfuel minerals into a final marketable product.



FIGURE 3. - Auger mining for coal—48-inch auger holes.



FIGURE 4. - Coal waste bank.

Placer mining is usually a surface mining method for recovering heavy minerals from unconsolidated deposits. Historically, gold is the most important mineral associated with placer mining; other minerals recovered by placer mining operations are ilmenite, columbium, tantalite, platinum, scheelite, and monazite.

Dredging is used extensively in placer gold mining. It is also used to recover sand and gravel from streambeds and low-lying lands and for stripping phosphate deposits in a coastal area of North Carolina.

The term "land use" covers land used for surface mine excavations and for the disposal of surface and underground mine waste and of waste from milling and processing operations. "Reclaimed" in this report means that reconditioning or restoration work has been completed on mined and waste disposal areas in compliance with Federal, State, or local laws, or that in the opinion of mine management, such areas have been restored to a useful condition.

EXTENT OF MINE LAND USE

Land use for mining from 1930 through 1980 (51 years), a period when mining activities were called upon to fulfill mineral requirements for three wars and an expansive economy, amounted to 5.7 million acres, or 0.25 percent of the total land mass in the United States (fig. 5). Taking into account the 47 percent of land reclaimed, 0.13 percent of the total land mass is currently being used for mining or mineral processing, is abandoned or derelict, or has been reclaimed by nature or voluntarily reclaimed by various industries and Federal, State, and local government agencies.

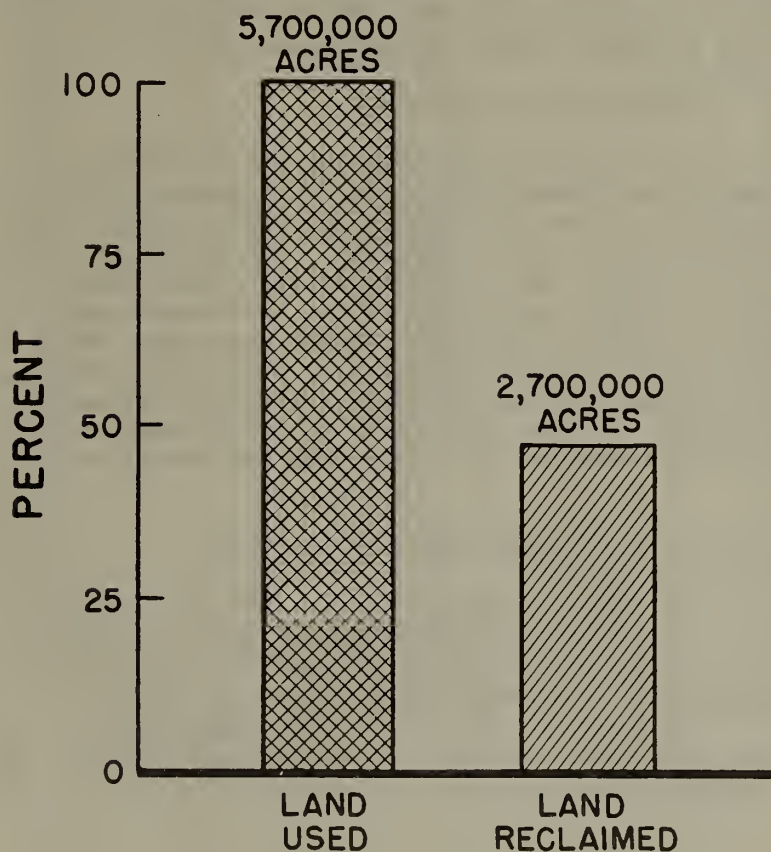


FIGURE 5. - Total land used and reclaimed in the mining industry, 1930-80.

The amount of land used for mining is small compared with that devoted to other types of uses--agriculture, 70.0 percent; national parks, 3.4 percent; urban areas, 3.0 percent; transportation networks (highways, railroads, airports, etc.), 1.3 percent; Forest Service wilderness, 1.1 percent; and wildlife refuges, 3.9 percent (table 1).

TABLE 1. - Comparison of major land uses in the United States in 1980,
by type of use¹

Activity	Million acres
Agriculture (1977 data):	
Cropland.....	413.0
Grassland, pasture, and range.....	985.7
Forest land grazed.....	179.4
Farmsteads, farm roads.....	10.9
Total.....	1,589.0
Urban and built-up areas ²	68.7
National park system ³	77.0
Wildlife refuge system ³	88.7
Forest Service wilderness ³	25.1
Highways (1978).....	21.5
Railroads (1978).....	3.0
Airports (1978).....	4.0
Mining ⁴	5.7
Other.....	388.6
Total.....	2,271.3

¹Estimates based primarily on reports and records of the Bureau of Census, the Department of Agriculture, and other Federal and State agencies.

²Includes residential, farm, industrial and recreational sites, and highways, railroads, and other transportation facilities within urban and built-up areas.

³Includes areas designated under the Alaska National Interests Lands Conservation Act, Dec. 2, 1980, Public Law 96-487.

⁴For the period 1930-80; includes 2.7 million acres reclaimed.

Every State experienced some form of mining activity during the reporting period. The percentage of land used by each State for mining and attendant activities ranges from 0.01 percent in Alaska to over 2.2 percent in Pennsylvania (table 2). In addition to Pennsylvania, five States (Kentucky, West Virginia, Ohio, Illinois, and Indiana) each had over 1 percent of their land mined. These States account for nearly half the land mined and for two-thirds of the land reclaimed nationally. Eight States (California, Florida, Illinois, Indiana, Kentucky, Ohio, Pennsylvania, and West Virginia) have mined acreage ranging from 217,000 to over 630,000 acres. Nine other States (Alabama, Arizona, Michigan, Minnesota, Missouri, New York, Tennessee, Texas, and Virginia) were in the 100,000 to 200,000-acre category. The remaining States each had less than 100,000 acres used for mining during the 51-year period (fig. 6).

Acreage Used and Reclaimed by Selected Commodity, by State

Seven commodities (bituminous coal, clays, copper, iron ore, phosphate rock, sand and gravel, and stone) accounted for 92 percent of the amount of land used during the 51-year period (table 3). Bituminous coal was responsible for nearly half the total area utilized (48 percent). The remaining 52 percent is distributed as follows: Sand and gravel, 17 percent; stone, 13 percent; phosphate rock, 5 percent; clays, 4 percent; copper, 3 percent; iron ore, 2 percent; and all other commodities including uranium, 8 percent (fig. 7).

TABLE 2. - Land utilized and reclaimed by the mining industry¹
in the United States in 1930-80, by State

State	Total State land area, ² acres	Percent of total land area used for mining	Total area utilized, ³ acres	Total area reclaimed, ³ acres	Percent reclaimed
Alabama.....	32,678,000	0.39	145,670	85,250	58.5
Alaska.....	365,482,000	.01	31,760	16,820	53.0
Arizona.....	72,688,000	.17	121,820	14,140	11.6
Arkansas.....	33,599,000	.09	39,190	13,490	34.4
California.....	100,207,000	.26	257,350	52,900	20.6
Colorado.....	66,486,000	.11	70,290	21,950	31.2
Connecticut.....	3,135,000	.55	17,310	4,210	24.3
Delaware.....	1,266,000	.22	2,830	650	23.0
Florida.....	34,721,000	.86	297,660	69,160	23.2
Georgia.....	37,295,000	.15	54,740	19,200	35.1
Hawaii.....	4,106,000	.19	7,750	2,170	28.0
Idaho.....	52,933,000	.09	45,380	9,510	21.0
Illinois.....	35,795,000	1.11	411,380	282,200	68.6
Indiana.....	23,158,000	1.13	260,660	180,760	69.4
Iowa.....	35,860,000	.19	61,910	26,470	42.8
Kansas.....	52,511,000	.11	57,780	32,320	55.9
Kentucky.....	25,512,000	2.09	533,410	385,400	72.3
Louisiana.....	28,868,000	.09	25,770	7,310	28.4
Maine.....	19,848,000	.09	18,490	6,910	37.4
Maryland.....	6,319,000	.71	45,080	18,740	41.6
Massachusetts.....	5,035,000	.62	31,270	8,300	26.5
Michigan.....	36,492,000	.35	128,720	31,660	24.6
Minnesota.....	51,206,000	.27	137,420	16,930	12.3
Mississippi.....	30,223,000	.06	16,700	4,990	29.9
Missouri.....	44,248,000	.32	143,440	67,500	47.1
Montana.....	93,271,000	.07	63,270	18,100	28.6
Nebraska.....	49,032,000	.04	21,360	6,580	30.8
Nevada.....	70,264,000	.06	40,080	5,830	14.6
New Hampshire.....	5,769,000	.12	7,190	1,980	27.5
New Jersey.....	4,813,000	.82	39,510	12,440	31.5
New Mexico.....	77,766,000	.09	69,290	15,180	21.9
New York.....	30,681,000	.36	110,990	26,260	23.7
North Carolina.....	31,403,000	.18	55,170	15,300	27.7
North Dakota.....	44,452,000	.12	53,230	34,700	65.2
Ohio.....	26,222,000	1.93	507,320	357,900	70.6
Oklahoma.....	44,088,000	.15	66,670	39,490	59.2
Oregon.....	61,599,000	.07	44,710	11,770	26.3
Pennsylvania.....	28,805,000	2.21	635,530	338,000	53.2
Rhode Island.....	677,000	.59	4,000	820	20.5
South Carolina.....	19,374,000	.11	20,800	8,150	39.2
South Dakota.....	48,882,000	.04	20,050	6,260	31.2
Tennessee.....	26,728,000	.40	106,160	48,870	46.0
Texas.....	168,218,000	.08	141,890	38,930	27.4
Utah.....	52,697,000	.15	78,490	7,520	9.6
Vermont.....	5,937,000	.12	7,640	1,990	26.1
Virginia.....	25,496,000	.55	139,110	69,630	50.1
Washington.....	42,694,000	.12	53,570	16,820	31.4
West Virginia.....	15,411,000	2.06	318,120	194,000	61.0
Wisconsin.....	35,011,000	.17	61,000	14,820	24.3
Wyoming.....	62,343,000	.13	81,460	29,720	36.5
Total ⁴	2,271,304,000	.25	5,700,000	2,700,000	47.4

¹Excludes oil and gas operations.

²U.S. Department of Commerce, Statistical Abstract of the United States 1972, p. 196.

³Includes area of surface mine excavation, area used for disposal of surface mine waste (includes coal, 1930-71 only), surface area subsided or disturbed as a result of underground workings (1930-71 only), surface area used for disposal of underground waste, and surface area used for disposal of mill or processing waste. Excludes areas used for haulroads, fresh water reservoirs, railroads and public highways to edge of mining properties, and streams affected by acid drainage and sedimentation.

⁴Data may not add to totals shown because of independent rounding.

TABLE 3. - Land¹ utilized by the mining industry in the United States in 1930-80,
by State and selected commodity, acres

State	Bituminous coal	Clays	Copper	Iron ore	Phosphate rock	Sand and gravel	Stone	Uranium	All other commodities	Total ²
Alabama.....	104,750	8,700	0	7,480	0	9,320	14,920	0	500	145,670
Alaska.....	5,090	10	200	0	0	9,520	1,010	10	15,900	31,760
Arizona.....	3,980	740	91,200	5	0	17,900	3,090	780	4,130	121,820
Arkansas.....	6,360	3,320	0	5	0	12,760	11,930	0	4,820	39,190
California.....	60	14,010	0	2,440	0	121,060	39,660	10	80,110	257,350
Colorado.....	17,450	2,450	30	60	0	24,900	5,980	330	19,090	70,290
Connecticut.....	0	920	0	0	0	9,630	6,660	0	100	17,310
Delaware.....	0	90	0	0	0	2,610	120	0	10	2,830
Florida.....	0	2,620	0	0	222,000	9,700	32,170	0	31,170	297,660
Georgia.....	420	25,770	0	380	0	4,820	20,400	0	3,000	54,740
Hawaii.....	0	60	0	0	0	650	6,010	0	1,030	7,750
Idaho.....	10	130	50	5	14,500	9,730	2,710	5	18,240	45,380
Illinois.....	336,510	8,990	0	0	0	32,480	32,450	0	950	411,380
Indiana.....	205,820	6,760	0	0	0	23,590	23,600	0	890	260,660
Iowa.....	1,460	4,080	0	0	0	19,970	31,310	0	5,090	61,910
Kansas.....	26,750	3,480	0	0	0	15,150	9,940	0	2,460	57,780
Kentucky.....	502,530	4,660	0	0	0	6,760	19,360	0	100	533,410
Louisiana.....	0	3,220	0	0	0	16,330	5,840	0	400	25,770
Maine.....	0	250	0	0	0	15,180	2,180	0	880	18,490
Maryland.....	14,060	3,460	0	0	0	17,520	9,840	0	200	45,080
Massachusetts..	0	630	0	0	0	20,340	10,290	0	10	31,270
Michigan.....	570	8,340	5,420	6,750	0	58,880	39,160	0	9,600	128,720
Minnesota.....	0	750	0	90,590	0	38,530	5,950	0	1,600	137,420
Mississippi.....	0	5,260	0	0	0	10,500	940	0	0	16,700
Missouri.....	61,600	10,340	0	1,030	0	13,300	30,020	0	27,120	143,440
Montana.....	14,740	610	16,750	10	3,070	15,810	5,610	5	6,670	63,270
Nebraska.....	0	660	0	0	0	17,110	3,570	0	20	21,360
Nevada.....	0	120	14,280	530	0	9,380	2,760	10	13,000	40,080
New Hampshire..	0	150	0	0	0	6,370	580	0	90	7,190
New Jersey.....	0	2,220	0	630	0	17,460	11,900	0	7,300	39,510
New Mexico.....	16,000	360	15,600	30	0	10,380	2,140	9,330	15,450	69,290
New York.....	0	5,530	0	1,910	0	42,560	33,920	0	27,070	110,990
North Carolina.	0	11,650	0	10	5,360	13,960	18,540	0	5,650	55,170
North Dakota...	42,320	190	0	0	0	10,570	100	20	30	53,230
Ohio.....	394,500	20,770	0	0	0	45,320	45,680	0	1,050	507,320
Oklahoma.....	36,310	3,220	390	0	0	7,900	15,270	0	3,580	66,670
Oregon.....	20	1,000	5	0	0	21,750	17,430	20	4,490	44,710
Pennsylvania...	427,000	14,070	0	730	0	34,370	54,150	0	105,210	635,530
Rhode Island...	0	0	0	0	0	3,170	490	0	340	4,000
South Carolina.	0	6,640	0	0	0	6,990	6,950	0	220	20,800
South Dakota...	390	1,360	0	5	0	14,250	3,240	330	510	20,050
Tennessee.....	41,780	6,510	1,070	20	21,600	9,920	24,650	0	610	106,160
Texas.....	8,890	17,330	5	1,090	0	41,480	54,480	890	17,730	141,890
Utah.....	3,360	1,020	42,450	3,470	2,750	13,590	4,200	60	7,590	78,490
Vermont.....	0	40	200	0	0	3,050	2,750	0	1,600	7,640
Virginia.....	85,530	5,060	5	10	10	16,180	28,370	0	3,950	139,110
Washington.....	3,452	1,170	120	5	0	29,800	16,800	410	1,810	53,570
West Virginia..	300,700	1,720	0	0	0	6,700	8,990	0	10	318,120
Wisconsin.....	0	450	0	2,050	0	39,660	18,660	0	180	61,000
Wyoming.....	49,220	8,690	0	1,560	960	8,280	5,560	5,220	1,970	81,460
Total ²	2,700,000	230,000	188,000	121,000	270,000	960,000	752,000	17,000	450,000	5,700,000

¹Includes area of surface mine excavation, area used for disposal of surface mine waste (includes coal, 1930-71 only), surface area subsided or disturbed as a result of underground waste, and surface area used for disposal of mill or processing waste. Excludes areas used for haulroads, fresh water reservoirs, railroads and public highways to edge of mining properties, and streams affected by acid drainage and sedimentation.

²Data may not add to totals shown because of independent rounding.

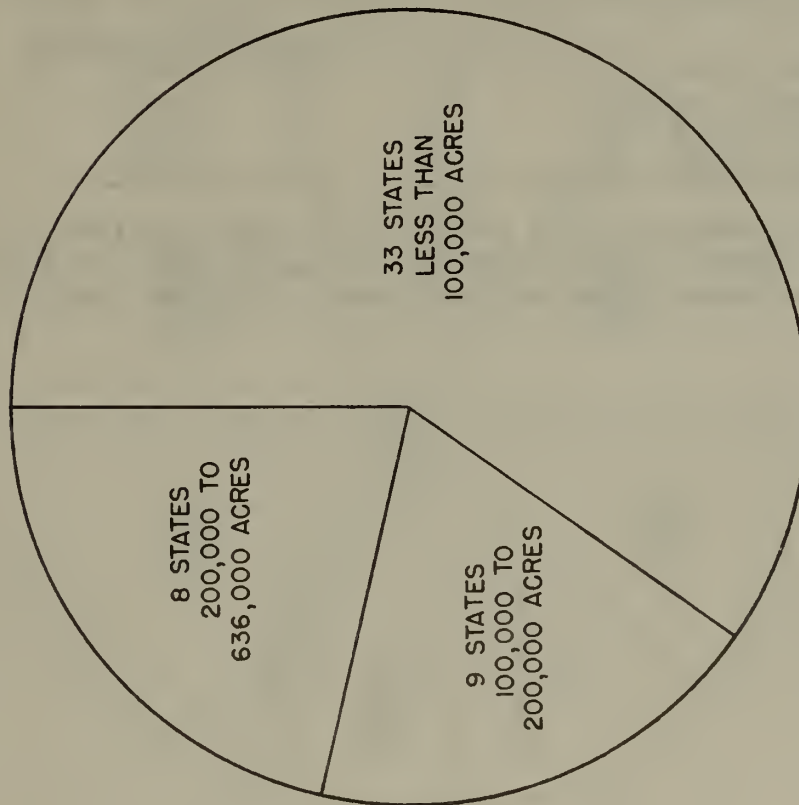


FIGURE 6. - Distribution of land used, by State cluster, 1930-80.

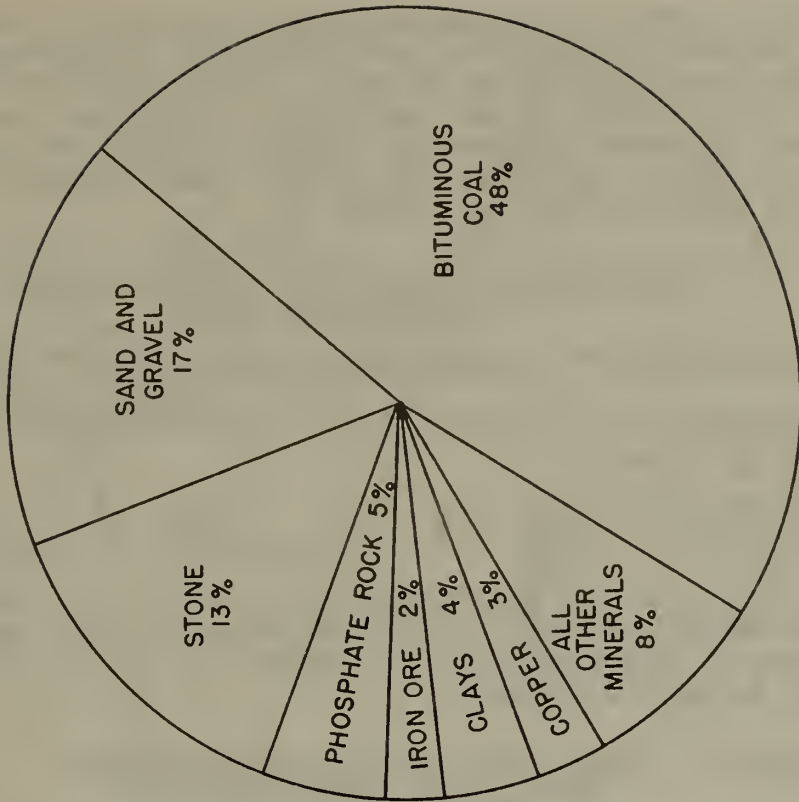


FIGURE 7. - Percentage of land used by selected commodity, 1930-80.

Seven States accounted for 84 percent of the land used for bituminous coal mining and included, in declining order, Kentucky, Pennsylvania, Ohio, Illinois, West Virginia, Indiana, and Alabama. All seven States exceeded the national average in the amount of land reclaimed, which ranged from 58 percent in Alabama to over 72 percent in Kentucky. Figure 8 shows land distribution for mining coal in 1930-80, and table 4 shows the acreage size distribution for mining coal by State for the same period.

TABLE 4. - Size distribution of acres utilized for coal
in 1930-80, by State

Acres utilized	Number of States	Percent of coal-producing States
Under 10,000.....	13	41.9
10,000 to 49,999.....	9	29.0
50,000 to 100,000....	2	6.5
Over 100,000.....	7	22.6

Forty-nine States reported clay production over the 51-year period; land use for clays was widespread, and no particular group of States emerged dominant in acreage used. Clay mining land use ranged from 10 acres in Alaska to over 25,000 acres in Georgia (table 5).

TABLE 5. - Size distribution of acres utilized
for clay in 1930-80, by State

Acres utilized	Number of States	Percent of clay-producing States
Under 1,000....	17	34.7
1,000 to 4,999.	15	30.6
5,000 to 10,000	10	20.4
Over 10,000....	7	14.3

Five States accounted for 95 percent of the area utilized for copper. Arizona was the leading State, accounting for nearly half the land used in the United States for copper mining and processing activities (fig. 9).

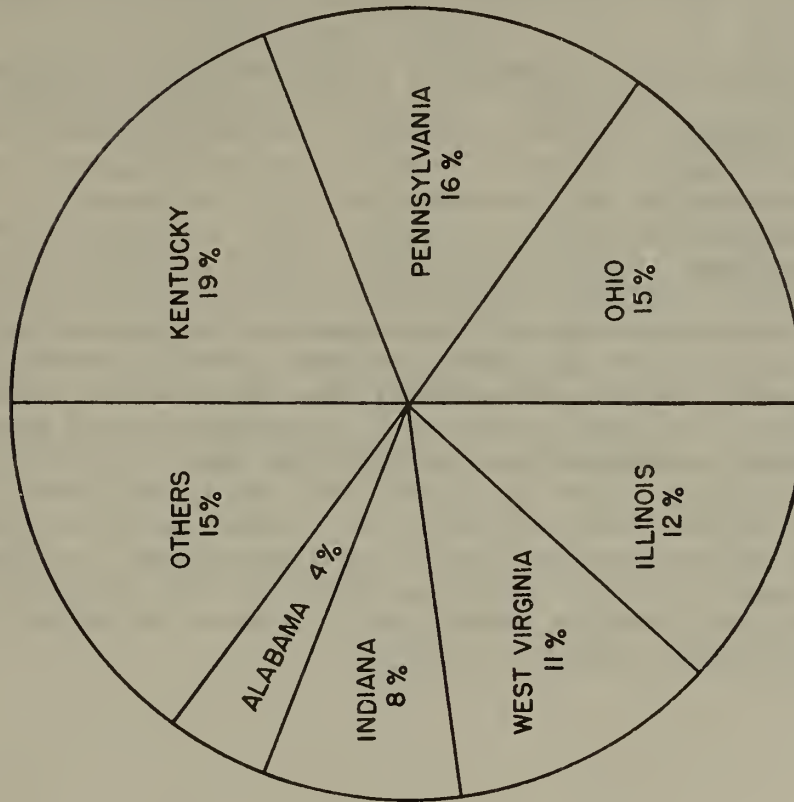


FIGURE 8. - Percentage of land used for mining bituminous coal, by State 1930-80.

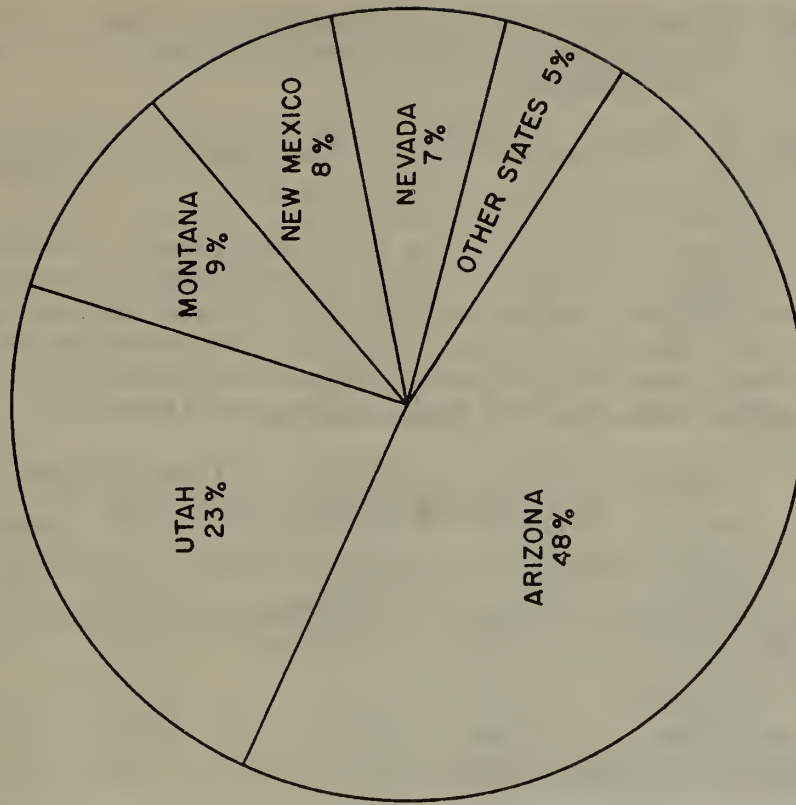


FIGURE 9. - Percentage of land used for mining copper, by State, 1930-80.

Minnesota was the dominant State in the quantity of land used in mining and processing iron ore, accounting for 75 percent of the total land used in the United States for that purpose.

Florida accounted for 82 percent of the land used in the extraction of phosphate rock.

California utilized 121,000 acres in the production of sand and gravel; this acreage was the highest in the country and amounted to 13 percent of the total land used for that commodity. All States reported sand and gravel extraction (table 6). Similarly, stone production was reported in all States; Pennsylvania and Texas were the dominant States, each accounting for about 7 percent of the total land used for stone production (table 7).

TABLE 6. - Size distribution of acres utilized for sand and gravel in 1930-80, by State

Acres utilized	Number of States	Percent of sand- and gravel-producing States
Under 5,000.....	5	10.0
5,000 to 9,999...	12	24.0
10,000 to 19,999.	18	36.0
20,000 to 50,000.	13	26.0
Over 50,000.....	2	4.0

TABLE 7. - Size distribution of acres utilized for stone in 1930-80, by State

Acres utilized	Number of States	Percent of stone-producing States
Under 5,000.....	16	32.0
5,000 to 9,999.....	10	20.0
10,000 to 19,999...	10	20.0
20,000 to 40,000...	11	22.0
Over 40,000.....	3	6.0

Bituminous coal also accounted for the bulk of the acreage reclaimed. Seventy-five percent of the land used for bituminous coal was reclaimed, compared with 8 and 27 percent respectively for areas affected by metal and nonmetal operations. The lower percentages of reclamation for metal and non-metal mining are due to several factors, including location in more sparsely populated areas in general than coal mining and lack of regulatory history; however, perhaps the most important factor is the nature of the operation. Unlike coal, most operations consist of large quarries and open pits that are worked for many years; typically large quantities of ore are removed while disturbing relatively small surface areas. Table 8 shows the amount of land used and reclaimed by selected commodity, 1930-80.

TABLE 8. - Land utilized and reclaimed by the mining industry
in the United States in 1930-80 and 1980,
by selected commodity

Commodity	Land utilized, ¹ acres		Land reclaimed, ¹ acres		Percent reclaimed 1930-80
	1930-80	1980	1930-80	1980	
Metals:					
Copper.....	188,000	2,570	5,400	190	2.9
Iron ore.....	121,000	2,040	5,100	80	4.2
Uranium.....	17,000	310	1,300	70	7.7
Other ²	182,000	4,240	29,200	650	16.0
Total.....	508,000	9,160	41,000	990	8.1
Nonmetals:					
Clays.....	230,000	6,920	86,100	3,220	37.4
Phosphate rock.....	270,000	19,420	65,200	4,830	24.2
Sand and gravel.....	960,000	38,800	296,000	13,140	30.8
Stone.....	743,000	27,560	174,400	7,640	23.5
Other ³	150,000	2,900	13,900	980	9.3
Total.....	2,353,000	95,600	635,600	29,810	27.0
Solid fuels:					
Bituminous coal.....	2,700,000	121,710	2,036,000	92,220	75.4
Other ⁴	118,000	870	17,000	380	14.4
Total ⁵	2,818,000	123,000	2,053,000	92,600	72.9
Grand total⁵.....	5,700,000	228,000	2,700,000	123,000	47.4

¹Includes area of surface mine excavation, area used for disposal of surface mine waste (includes coal, 1930-71 only), surface area subsided or disturbed as a result of underground workings (1930-71 only), surface area used for disposal of underground waste, and surface area used for disposal of mill or processing waste. Excludes areas used for haulroads, fresh water reservoirs, railroads and public highways to edge of mining properties, and streams affected by acid drainage and sedimentation.

²Bauxite, beryllium, gold, lead, manganese, mercury, molybdenum, nickel, platinum-group metals, silver, titanium, tungsten, vanadium, and zinc.

³Aplite, asbestos, boron minerals, diatomite, feldspar, fluorspar, garnet, graphite, greensand marl, gypsum, kyanite, lithium minerals, magnesite, mica, millstones, olivine, perlite, potassium salts, pumice, pyrites, salt, sodium carbonate, talc, tripoli, vermiculite, and wollastonite.

⁴Anthracite and peat.

⁵Data may not add to totals shown because of independent rounding.

Acreage Used and Reclaimed by Mining Function

For lands associated with mining activity, over two-thirds of the acreage is used for excavations associated with surface mining (69 percent). The disposal of overburden waste (includes coal, 1930-71 only), processing waste, waste from underground mining operations, and surface subsidence (1930-71 only) account for the remaining 31 percent of land utilized (fig. 10).

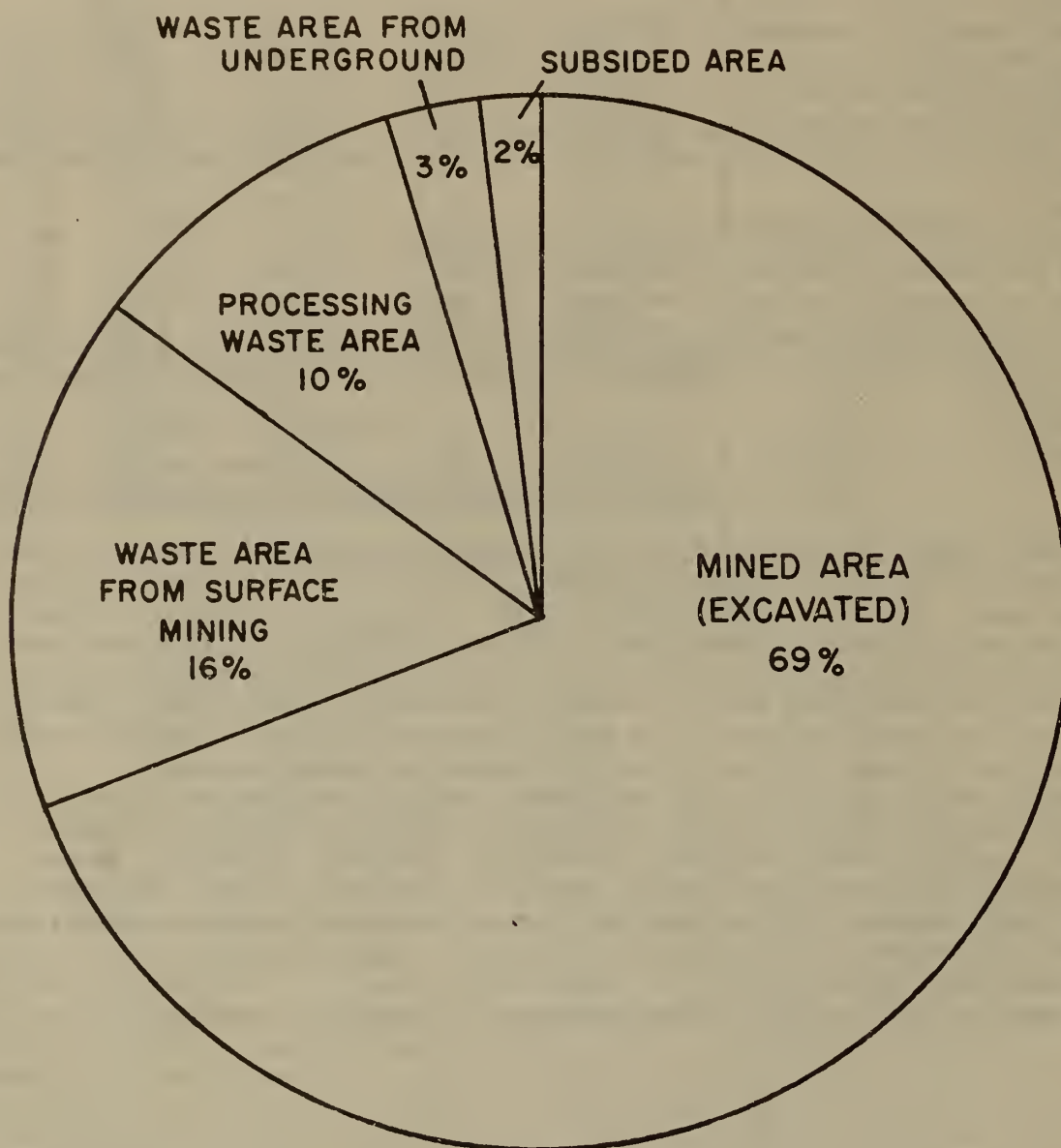


FIGURE 10. - Percentage of land used by mining function, 1930-80.

Areas affected by surface mine excavations and areas used for disposal of overburden wastes have the highest percentages of reclamation, 55 and 52 percent, respectively. The remaining reclaimed areas are distributed as follows: Surface area used for disposal of underground waste, 13.4 percent; surface area used for disposal of mill or processing waste, 9.4 percent; and surface area subsided or disturbed as a result of underground workings, 5.6 percent (table 9).

TABLE 9. - Land utilized and reclaimed by the mining industry in the United States in 1930-80,
by area of mining activity¹

Area of activity	Utilized, acres	Reclaimed, acres	Percent reclaimed
Surface area mined (area of excavation only).....	3,933,910	2,158,500	55.0
Area used for disposal of overburden waste from surface mining ²	910,000	472,000	52.0
Surface area subsided or disturbed as a result of underground workings ³	105,000	5,870	5.6
Surface area used for disposal of underground mine waste.....	190,320	25,500	13.4
Surface area used for disposal of mill or processing waste.....	554,000	51,800	9.4
Total ⁴	5,700,000	2,700,000	47.4

¹Excludes oil and gas operations.

²Includes surface coal operations for 1930-71 only.

³Includes data for 1930-71 only.

⁴Data may not add to totals shown because of independent rounding.

CONCLUSIONS

Mining, especially surface mining, is a very conspicuous form of land use which over the years has generated considerable concern about its impact on other resources. Yet, compared with other land uses, mining involves a very small portion of the total land mass in the United States.

During the 51-year period 1930-80, the mining industry used 5.7 million acres, or 0.25 percent of the total U.S. land mass, to meet the Nation's fuel and nonfuel mineral needs. Nearly half (47 percent) of the land utilized was reclaimed by the mining industry, and although 53 percent was not reclaimed by the industry, not all of this unreclaimed land remains in an abandoned condition. Some lands abandoned years ago have been reclaimed by nature and cannot be identified for reclamation purposes. Others were voluntarily reclaimed by the mining industry (figs. 11 and 12) before the existence of State or Federal laws for such uses as farming, grazing, and other purposes and cannot now be accurately accounted for. Still others have been reclaimed by other industries for such uses as highways, for recreation, industrial, and residential complexes, and for demonstration of reclamation techniques (fig. 13). Therefore, conclusions as to the total amount of land that remains in an abandoned condition cannot be drawn from this report.



FIGURE 11. - Abandoned strip pit before backfilling.



FIGURE 12. - Abandoned strip pit after backfilling.

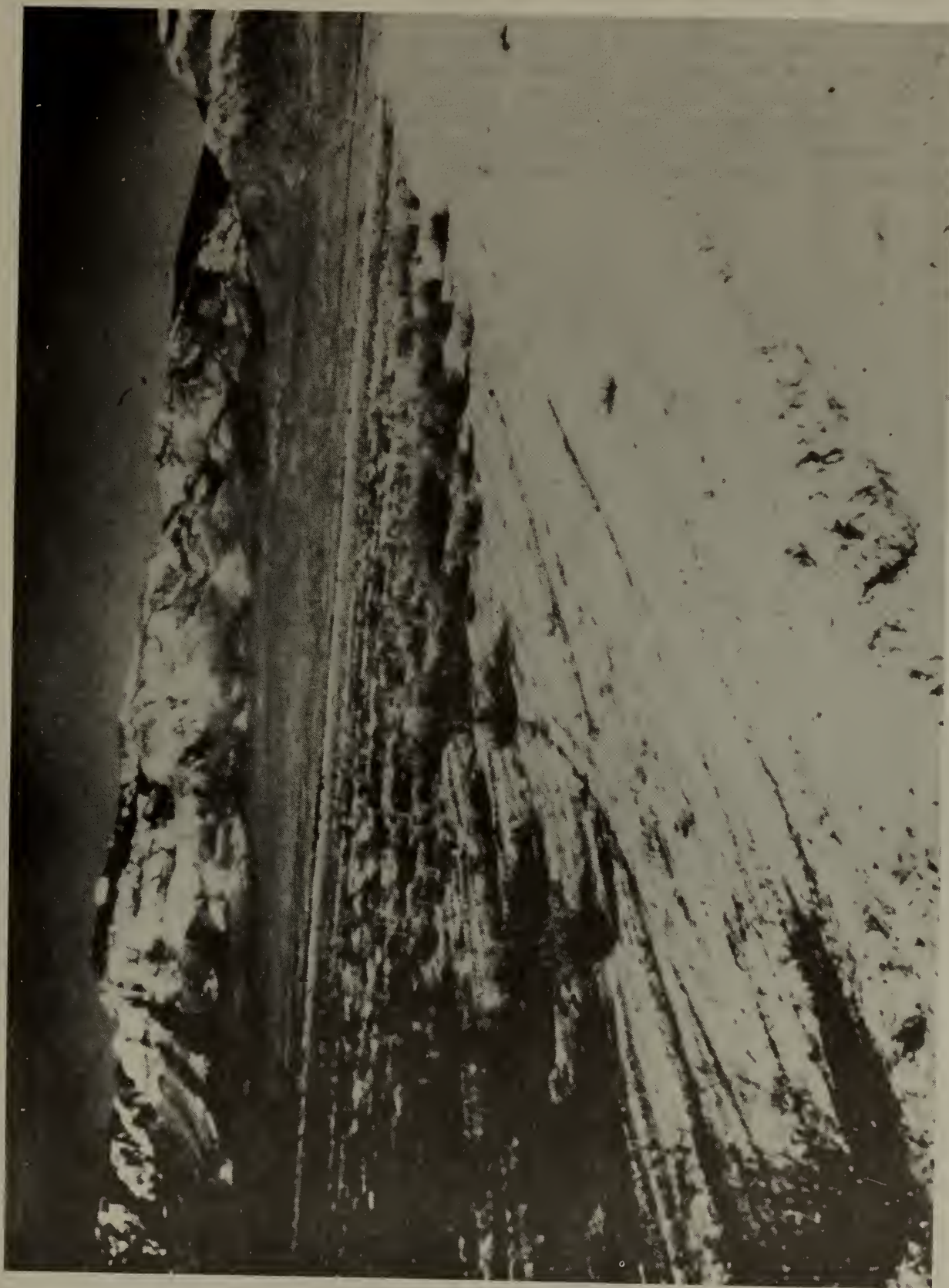
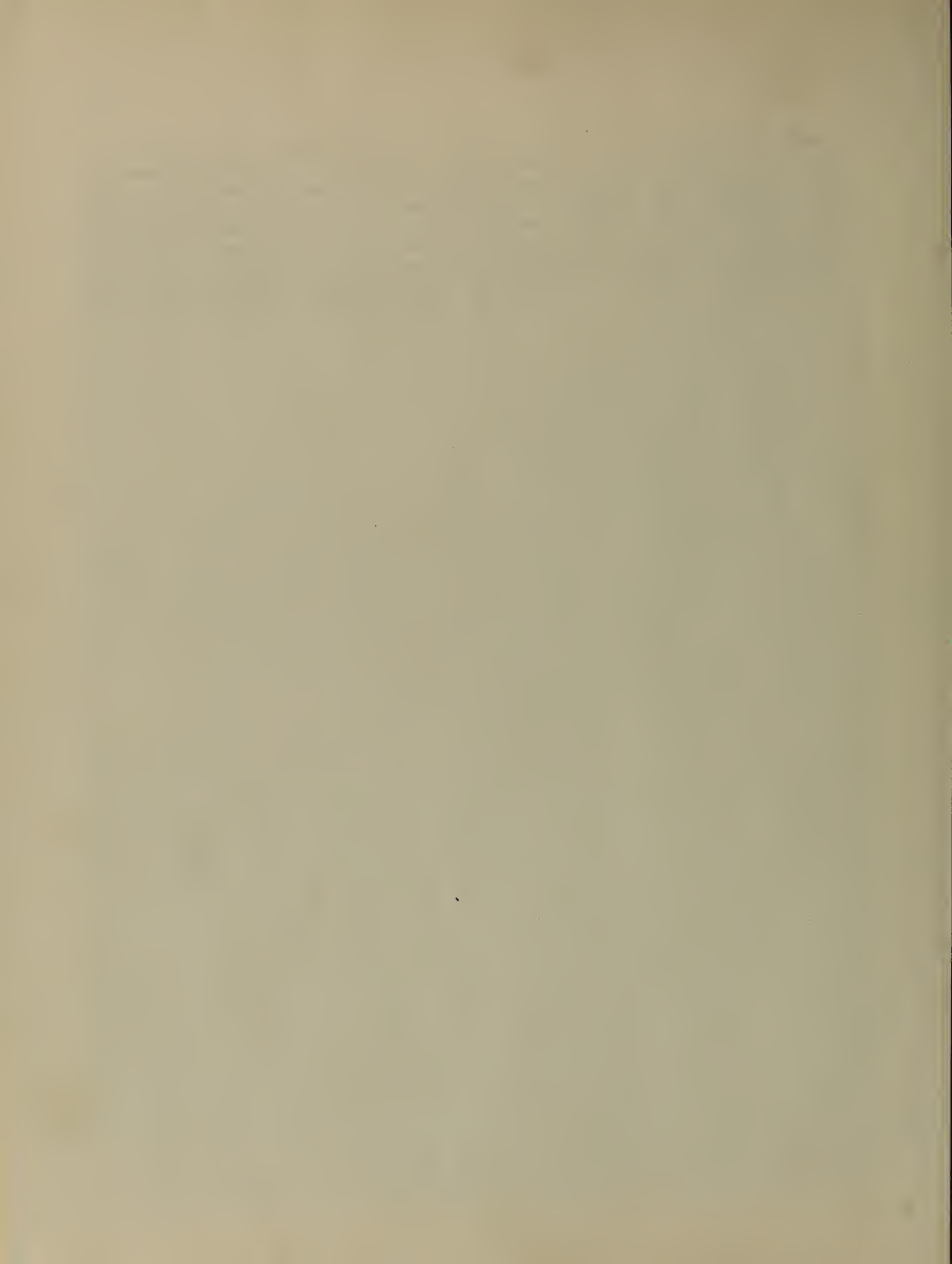


FIGURE 13. - Stabilized copper mill tailings pond.

Although more land continues to be used for mining, the trend in land reclamation continues to increase. With respect to coal, State and Federal laws provide for reclamation of all lands disturbed by surface mining. With the present trend in State law development governing mineral production, it is anticipated that reclamation of lands affected by nonfuel mineral mining will continue to increase; however, because such operations last for years, extracting large quantities of minerals while disturbing relatively small surface areas, reclamation of mineral lands will continue to be at a slower rate than reclamation of lands affected by coal mining.



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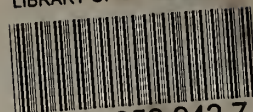
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